1st LHC Collimation Upgrade Specification Meeting
CERN, Geneva
20th January 2012

Study of IR collimation in the DS

Kick-off meeting

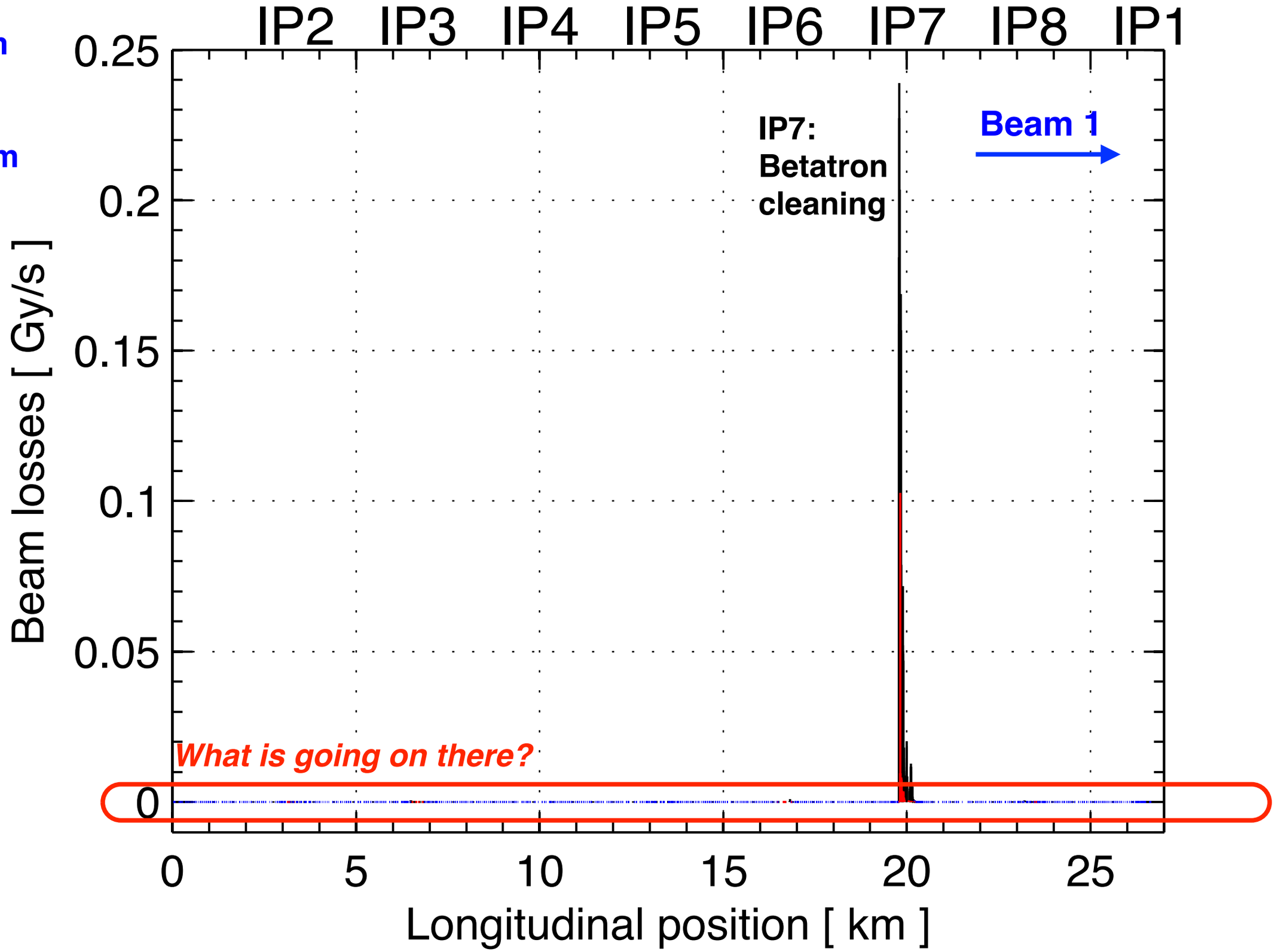
Stefano Redaelli and Ralph Assmann, BE-ABP

Outline

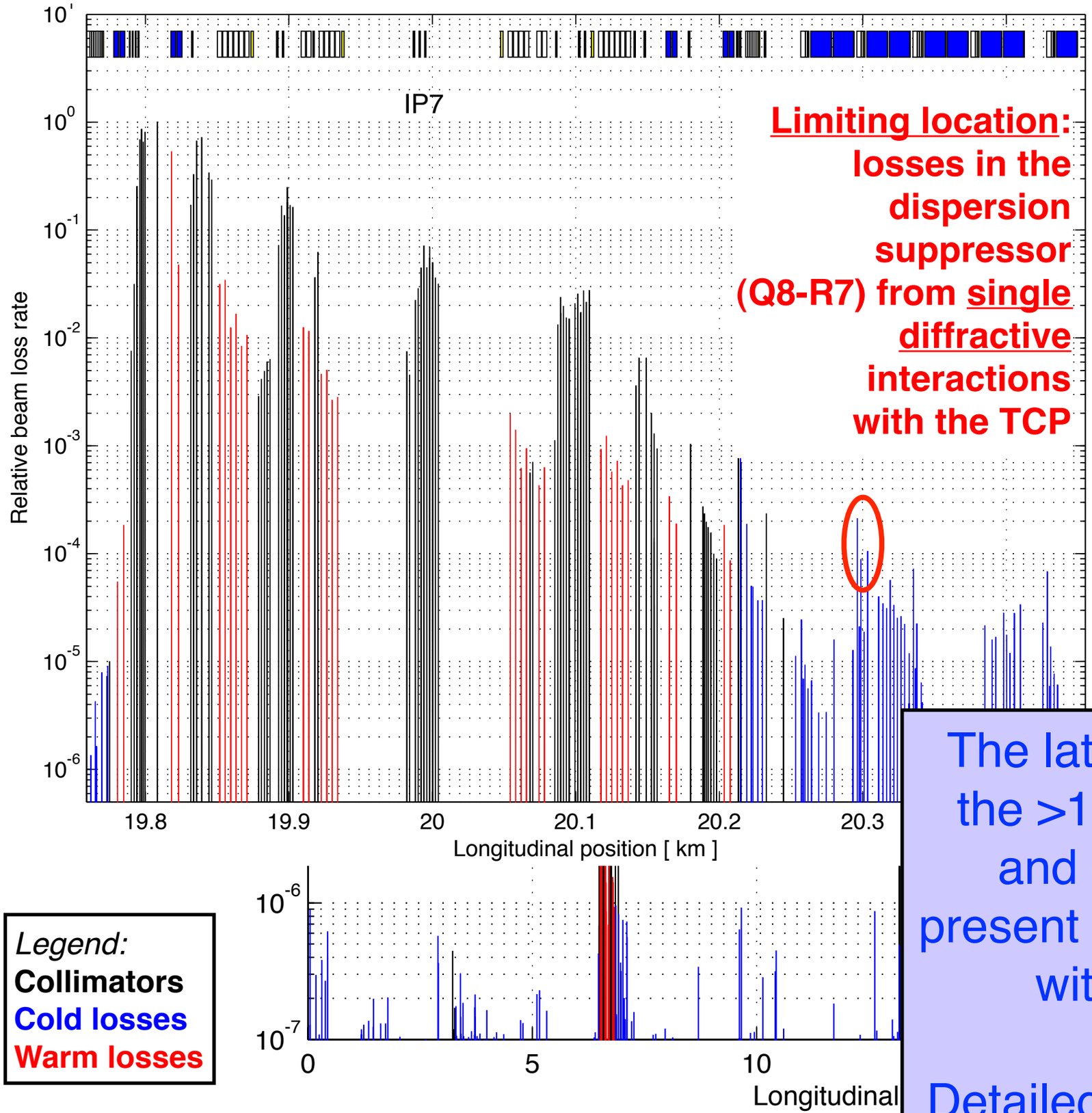
- ☑ Background
- ☑ Mandate
- ☑ General aspects
- ☑ Goals

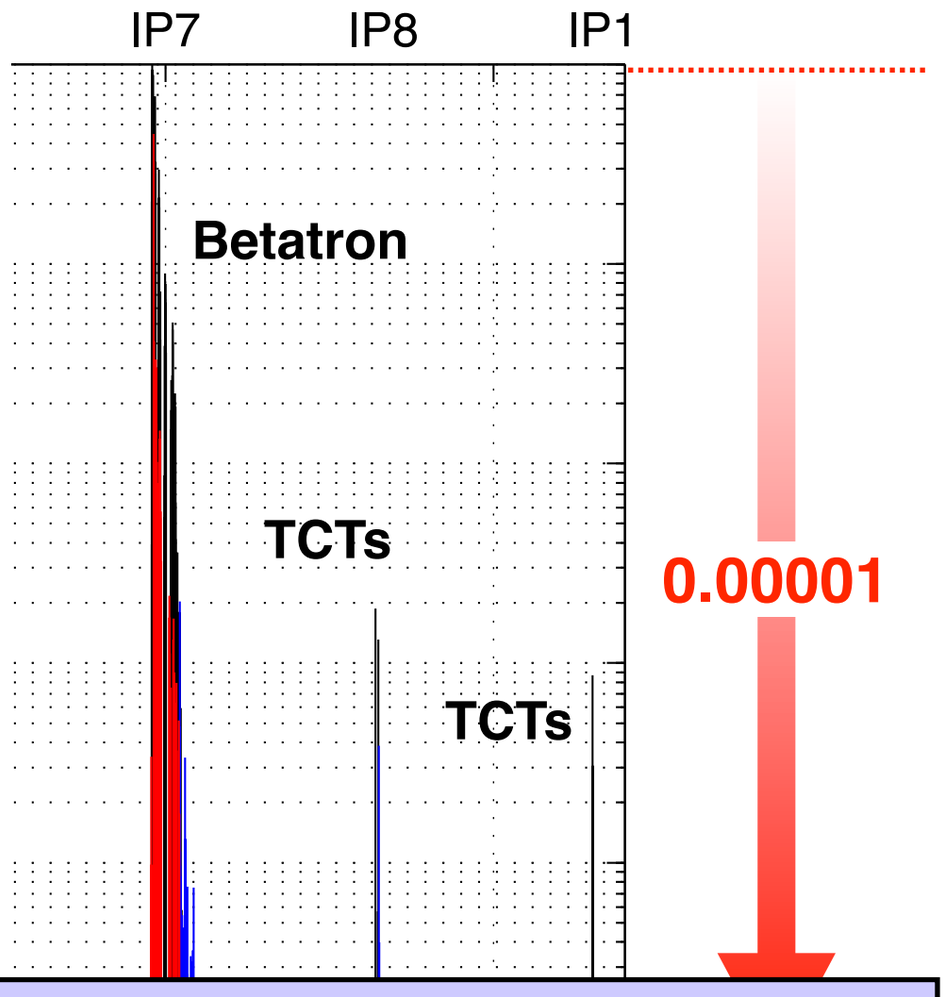
Highlight of present LHC collimation

4000 beam loss monitors along 27 km



Betatron cleaning at 3.5 TeV, β*=1.0 m

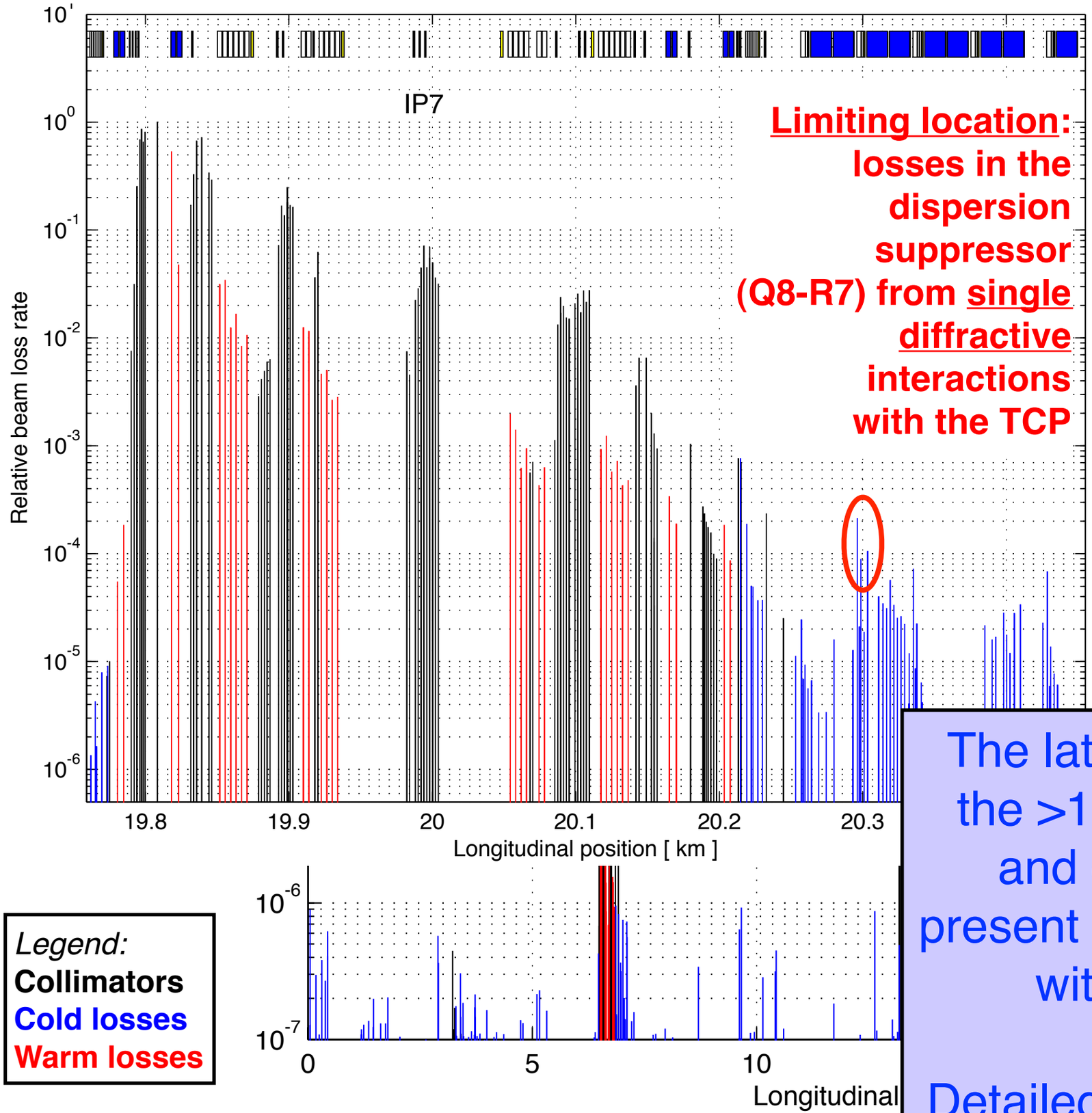


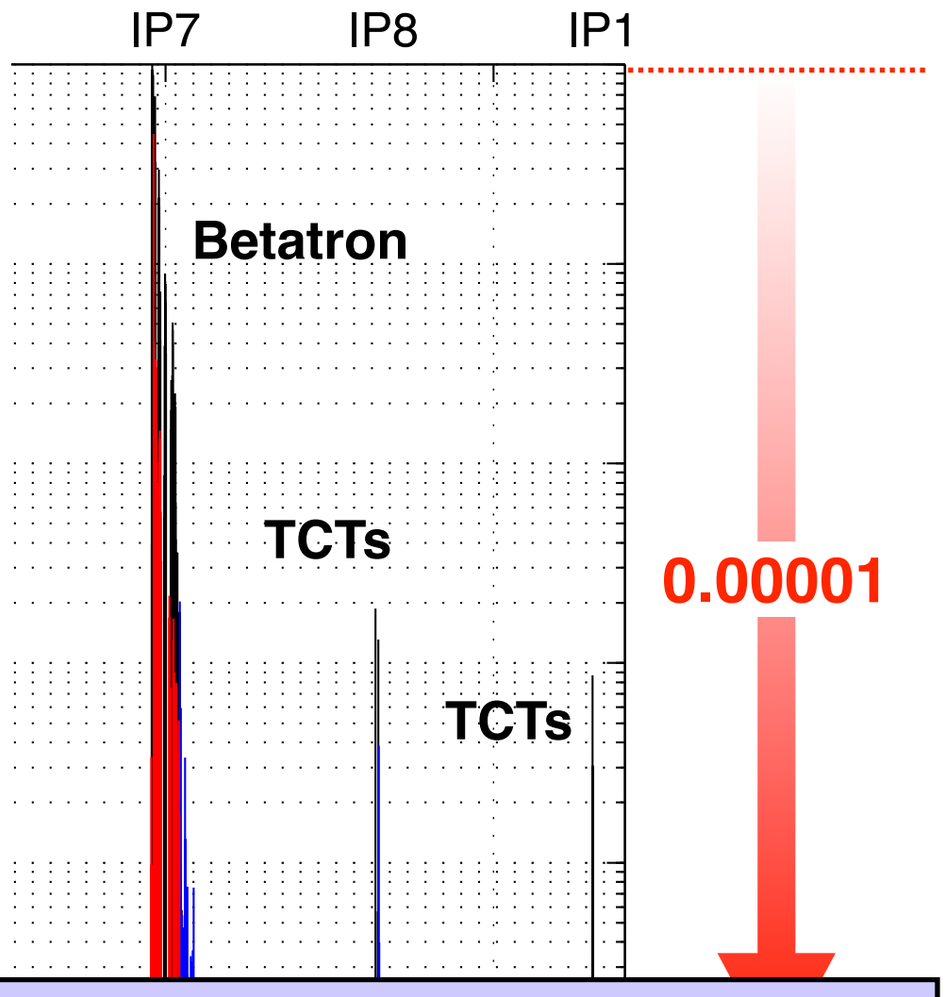


The latest machine performance in the >100MJ stored energy regime and quench tests indicate that present cleaning might be compatible with ultimate performance.

Detailed presentations at Cham2012

Betatron cleaning at 3.5 TeV, β*=1.0 m





Legend:
Collimators
Cold losses
Warm losses

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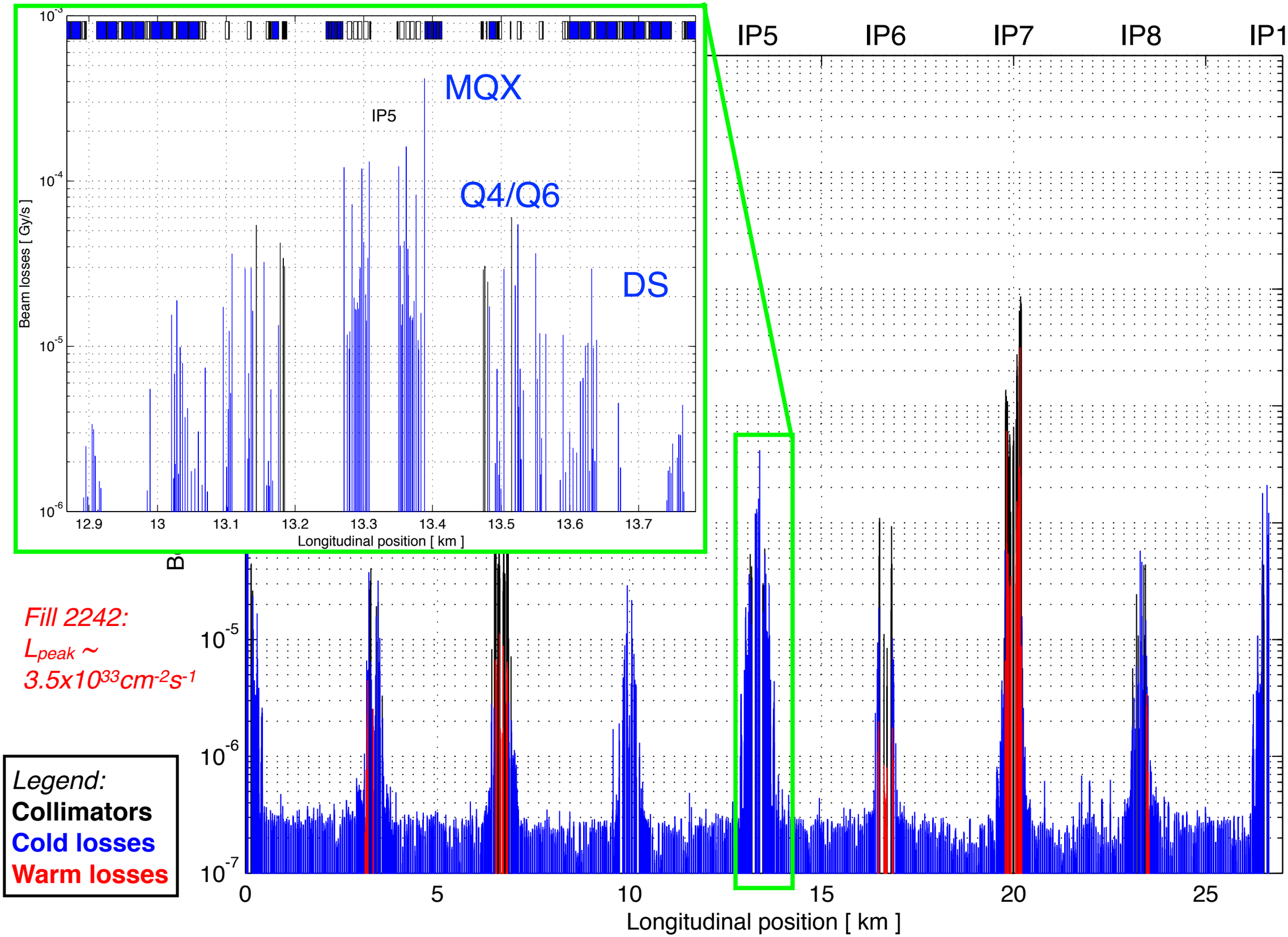
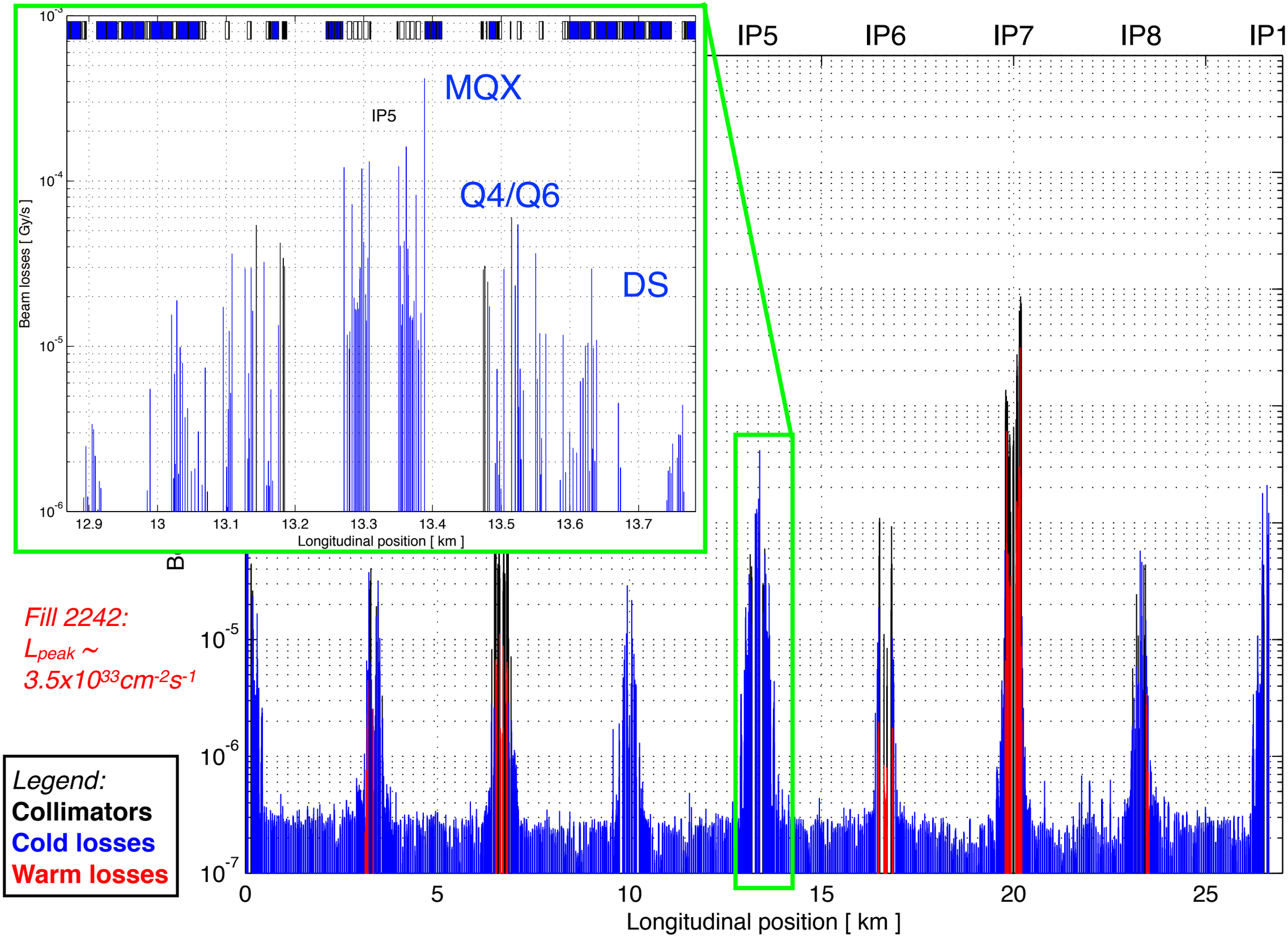
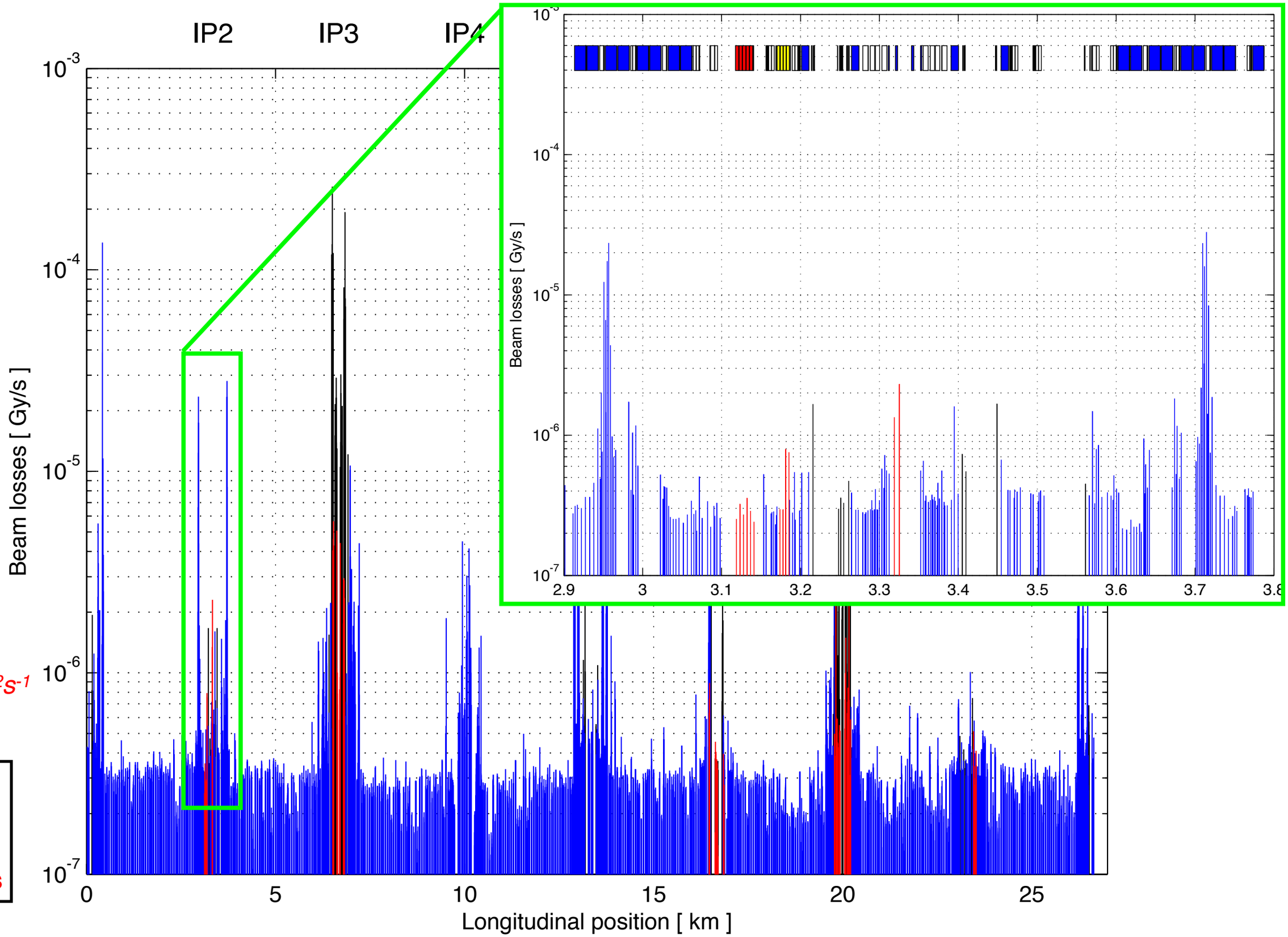
Losses in Physics



Losses in Physics



Ion losses in physics



Fill 2328:
L_{peak} ~
$4.5 \times 10^{26} cm^{-2} s^{-1}$

Legend:
Collimators
Cold losses
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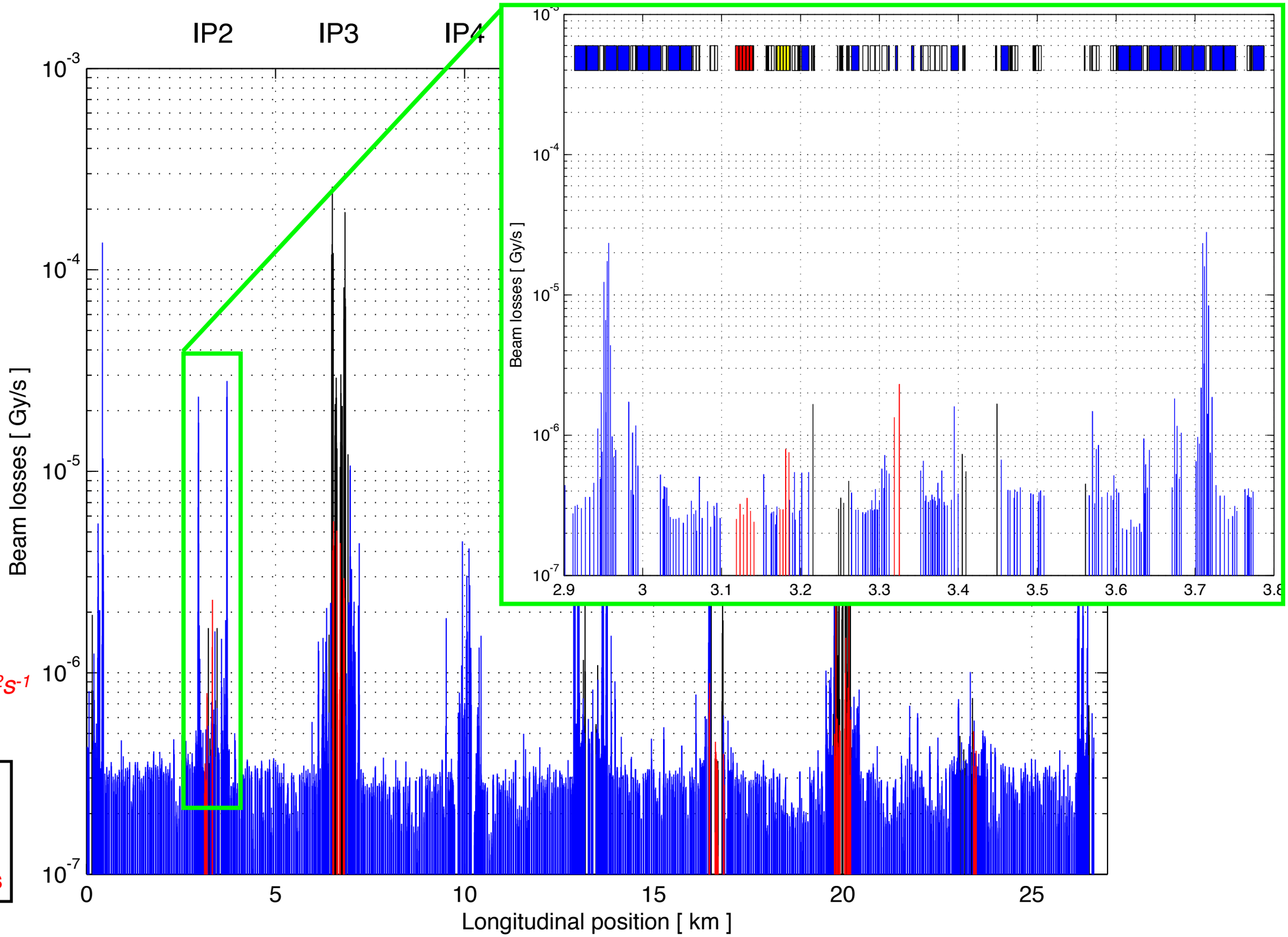
Ion losses in physics



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Legend:
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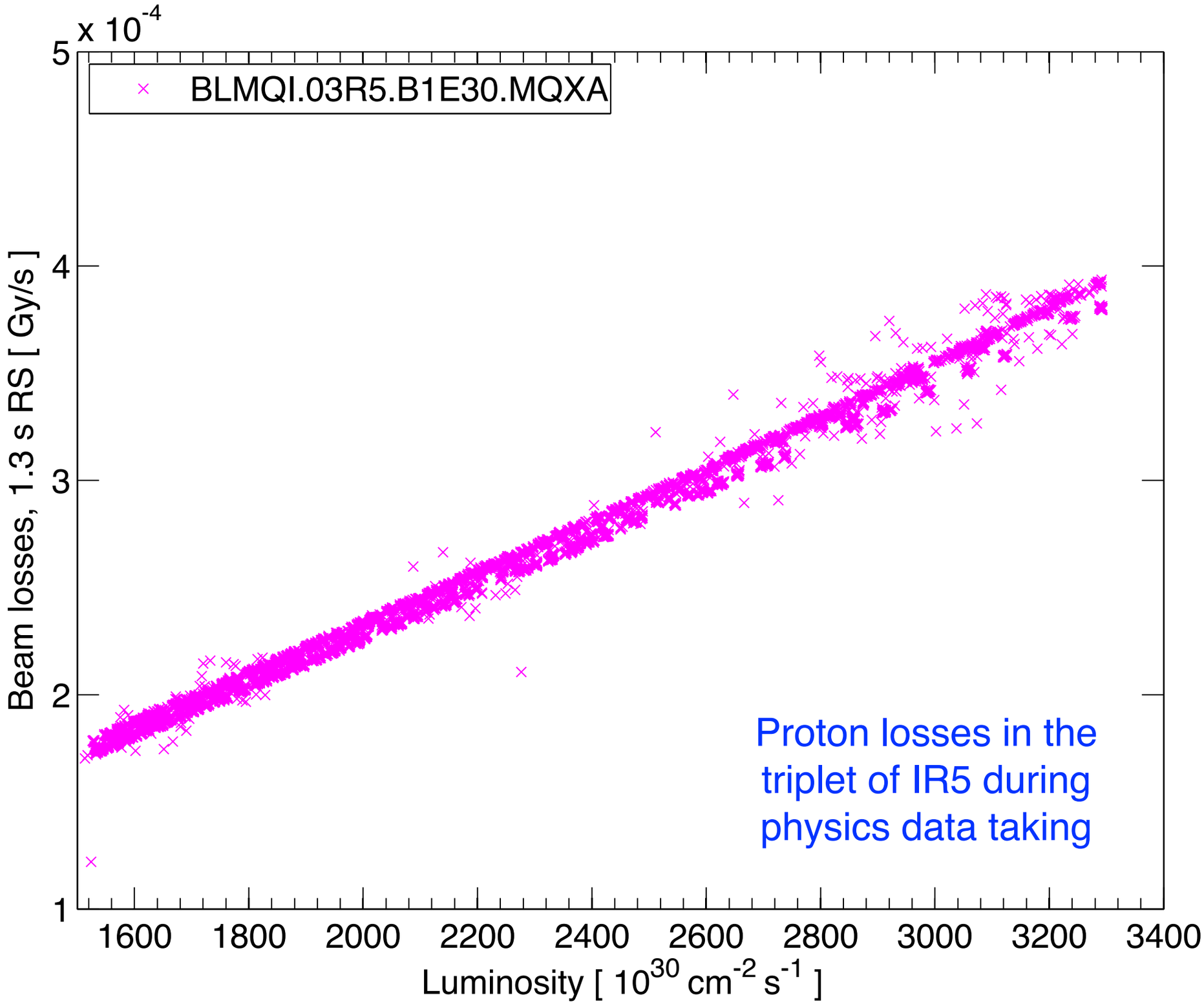
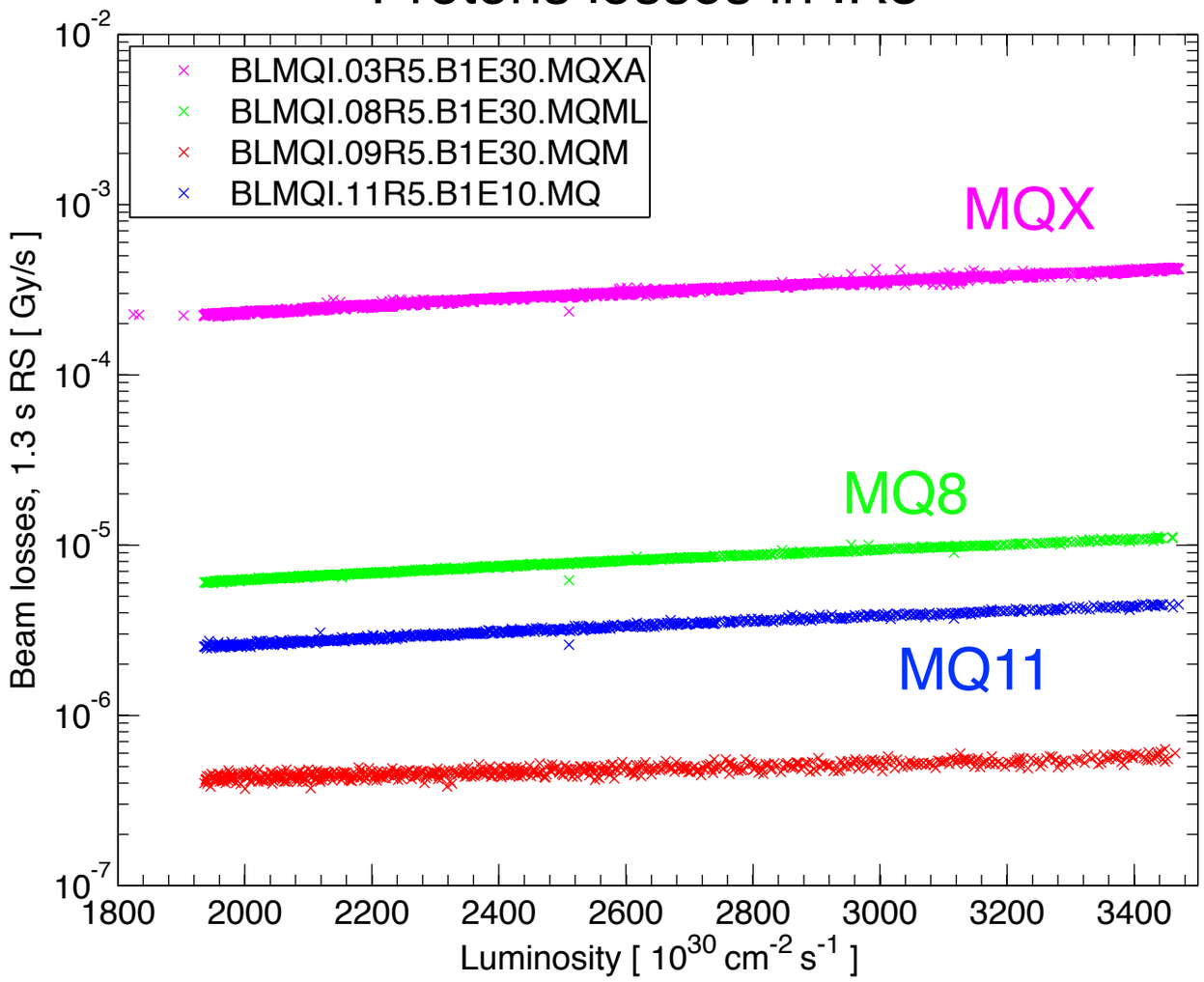
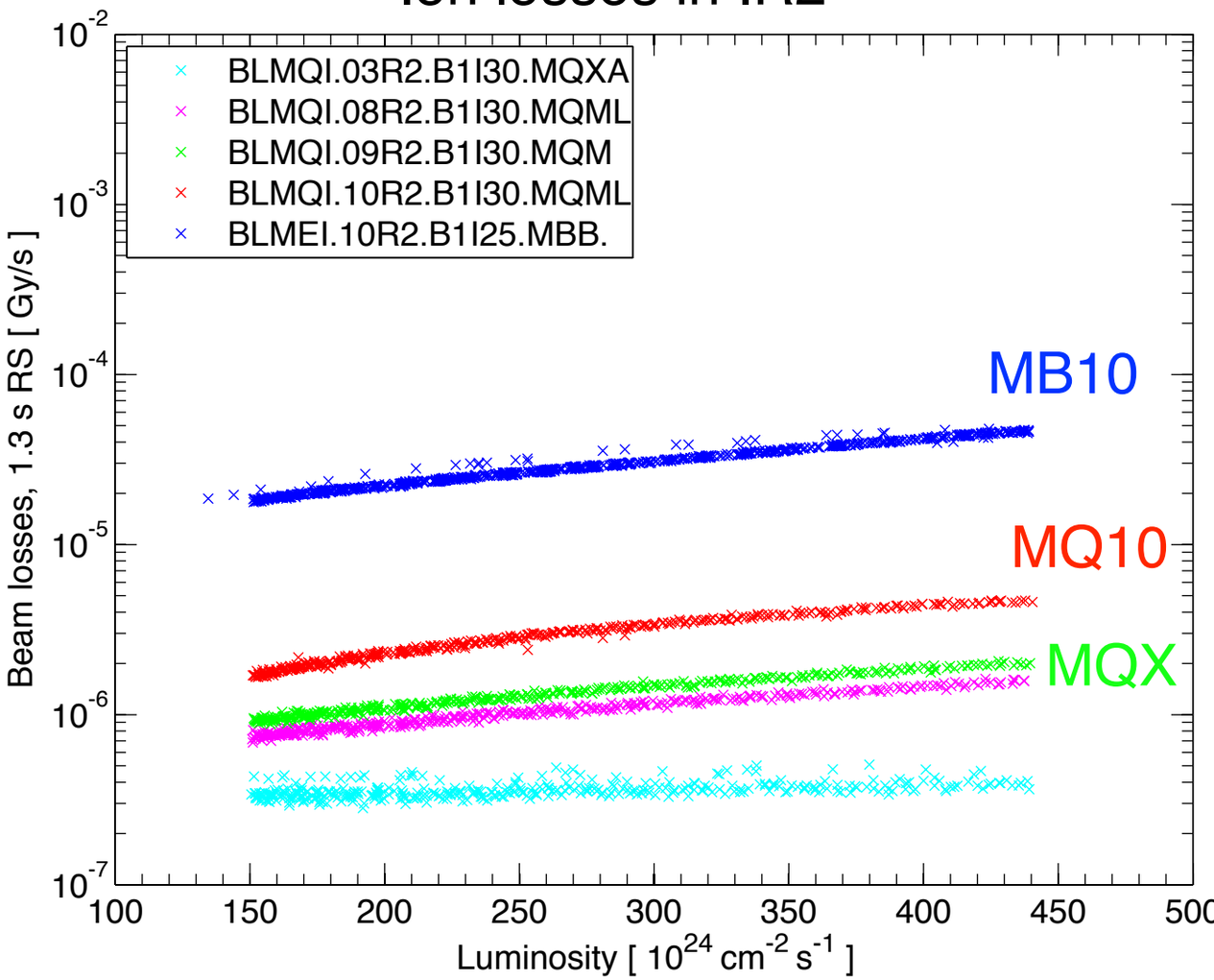
Triplet losses during proton runs



Losses in the DS of IR1/2/5





Large loss also for ions that affected operation already!
Issues: operational efficiency, radiation, magnet lifetime, ...

No details discussed here.

Local collimation in the dispersion suppressor is the cure to these problems!

Draft mandate of this working group

Study beam dynamics and operational aspects of new collimation schemes in the dispersion suppressors of the insertion regions of the LHC, for upgrade scenarios beyond LS1. Identify open issues and assign priorities to the work required and provide the necessary inputs to the team involved, including external collaborators.

Focused on specification documents, covering:

- *Layout: how many DSs equipped with collimators, where exactly?*
- *Different species: solution must work for ions and protons*
- *Optics: present optics and upgrade options for Hi-Lumi*
- *Define Jaw material, dimensions, settings, operational aspects*
- *Inputs to FLUKA studies (beam halo + luminosity debris)*
- *Define target performance improvements*
- *Define choices of new collimator materials in the different IRs*

Invitation and information list

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For this first meeting, I contacted 1 or 2 representative from the concerned team:

ABP optics (present+upgrade)

ABP + RF: impedance

Ions

LHC operations

Beam instrumentation

Machine protection

Beam dump / injection

Radio protection

FLUKA team

EN teams (controls, engineering, production)

TE (VAC, layout, planning)

External collaborators (within Hi-Lumi)

Manchester

Valencia

Royal Holloway

FNAL?

Management: not yet included

Remote handling: needed for this meeting?

Separated emails for invitation/minute distribution?

General aspects

- Runs in parallel to the Collimation Study Group
- Indicatively, we will meet every 2 weeks
- Regular reports from other activities
  (CCFS WG, Design WG, FLUKA studies, external collaborators)
- Slot of Friday afternoon seems okay for most people
- Minutes for each meeting will be prepared
- Secretary to be appointed
- Set up a web page
- Phone connections to external collaborators - TBD

Initially focused on simulation setup - not all teams needed until we setup discussion on full technical evaluation.

Goals and preliminary timeline

- Set-up of simulation environment
  for protons and ions: Feb. - Mar.
- Detailed analysis of beam data,
  comparison with simulations: Feb. - Mar.
- First feedback on LS2 layout
  using the present optics (for LS2): Spring
- Detailed simulation studies covering
  various cases / machine configurations: Spring +
- Then, full technical evaluation can start!
  Address mechanical/integration aspects,
  detailed integration aspects,
  trade-off engineering vs performance...

Next meeting

February 3rd
CCC meeting room

Tentative agenda:
V. Parma: Report from CCFS meeting
S. Redaelli: Dry-run of Chamonix presentation on collimation upgrade

Reserve slides

From Ralph's slides at HI-Lumi WS

- **WP 5.1: Coordination & Communication**
  - To coordinate and schedule work package tasks
  - To monitor work progress and inform the project management and work package participants
  - To follow up the WP budget and use of resources
  - To prepare internal and deliverable reports
- **WP 5.2: IR Simulations of Halo Loss**
  - Assess locations and magnitudes of halo loss in the IR's for various upgrade scenarios (includes crab cavities, ATS, …).
  - Assess impact of imperfections.
- **WP 5.3: IR Simulations of Energy Deposition**
  - Assess locations and magnitudes of energy deposition in the IR's for various upgrade scenarios.
  - Assess impact of imperfections.
- **WP 5.4: Design of IR Collimation**
  - Study required collimation to keep losses at the same level or below before the upgrade.
  - Integration of collimators, new layout and optics.
  - Feed forward to simulation WP's.

IR upgrade Hi-Lumi, after initial DS work with present layout

From 11T dipole workshop

Work Ahead for DS Collimation Concept

1. Specify cases for collimation (p intensity, ion intensity, lifetimes, p-p luminosity, Pb-Pb luminosity, any other future use cases) for IR1/2/3/5/7/8 independently, including HL-LHC parameters!
2. Define candidate locations for DS collimators, candidate material and candidate jaw length (also 1-sided vs. 2-sided).
3. Define gaps for DS collimators.
4. Simulate collimation efficiency (SixTrack with Collimation) for defined cases. Vary parameters (material, length, gaps).
5. Possibly iterate location until losses for all cases are reliably intercepted (study 1 versus 2 collimators per DS).
6. Once OK for beam losses, define reference case (material, length, gaps, locations). Define power load. Try to have one collimator solution.
7. Calculate energy deposition (FLUKA) and heating for defined cases, including accident cases.
8. Calculate jaw temperature and cooling. Check response to accident cases (ANSYS). Define design reference case.
9. Check impedance and trapped modes (RF simulations).
10. Iterate if necessary.
11. Freeze design.

R. Assmann